

RESEARCH NOTE

Wayne Grimm's legacy: A 40-year experiment on the dispersal of *Cepaea nemoralis* in Frederick County, Maryland

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The American-Canadian malacologist F. Wayne Grimm (1941–2005) started surveying the land snails of Maryland and Virginia in the 1950s and continued until his emigration to Canada in 1969. In 1977, Grimm's malacological activities went into a long hiatus as he turned to other pursuits. The revival of his interest in gastropods in the early 1990s ended when Grimm died from complications of diabetes in 2005 (F. Schueler, pers. comm.).

In a recapitulation of the surveys he had done in Maryland, Grimm (1971: 51) listed more than 100 terrestrial gastropod taxa, including the European snail *Cepaea nemoralis* (Linnaeus, 1758) with this annotation: "Deliberately introduced to Frederick Co. from Warm Springs, Va., in July, 1969." Grimm revealed neither the exact location of this introduction, nor the identity of the responsible person, although he himself was a likely culprit as he had earlier introduced *C. nemoralis* to the yard of his house in Baltimore (Reed 1964). A clue to the whereabouts of the introduced *C. nemoralis* emerged 24 years later when Counts and Weissman (1993: 22) reported finding a *C. nemoralis* shell that year in Frederick County "approximately 200 m north of Route 40." To our knowledge, no other record of *C. nemoralis* from Frederick County has been published since 1971.

In 2002, one of us (TP) e-mailed Grimm for more information about the locality of *Cepaea nemoralis* in Frederick County. Grimm responded with a phone message. The relevant parts of the message, transcribed by TP and e-mailed to AÖ in May 2002, were: "The place in Frederick County where the snails were introduced is the old Monocacy River bridge, where US 40 crossed it at one time. I went there in 1996 and found every trace of the bridge gone, and all the weeds around it were gone, too, so I strongly suspect that the snails are no longer there, but it might be a valid thing to take a look at them. Again, the old Monocacy River bridge in

Frederick Co., which was the old US40 bridge, right at the weedy spot that was there back in the 60s, actually the 50s. I introduced them quite a long time ago."

Although Grimm had revealed the missing pieces of the puzzle, our intention in 2002 to search for Grimm's *Cepaea nemoralis* was soon forgotten. Then in May 2009—almost exactly 40 years after Grimm's release of *C. nemoralis*—JS came upon large, colorful snails near a highway culvert in Frederick County. He e-mailed their pictures to AÖ who identified the snails as *C. nemoralis*. This find rekindled our interest in Grimm's snails and initiated a survey that has delineated their current range.

Our survey took place between May 2009 and January 2010. We searched for snails at 79 stations, coded FR-2 through FR-80, around Grimm's point of introduction on both sides of the Monocacy River (Fig. 1). We obtained GPS coordinates of each station and corrected them when necessary using Google Earth. We measured the maximum dispersal distances using Google Earth along straight lines between the point of introduction and the furthestmost stations where *Cepaea nemoralis* was found. To estimate annual dispersal rates, we divided maximum dispersal distances by 40 years. A list of stations and coordinates is available from the authors. Voucher specimens have been deposited in the Carnegie Museum of Natural History (CM102302–102303, 102856–102857, 102859, 102863–102865, 102867–102870, 102877, 102888).

Presently, three bridges cross the Monocacy River east of the city of Frederick (Fig. 1). The northern and newest bridge, built in the late 1980s, is for US40 and I-70. Approximately 600 m south are two other bridges. The one built in 1954 currently handles both westbound and eastbound traffic on MD144; but prior to 1990 carried only eastbound traffic. The adjacent bridge, built in 1942, carried westbound traffic until

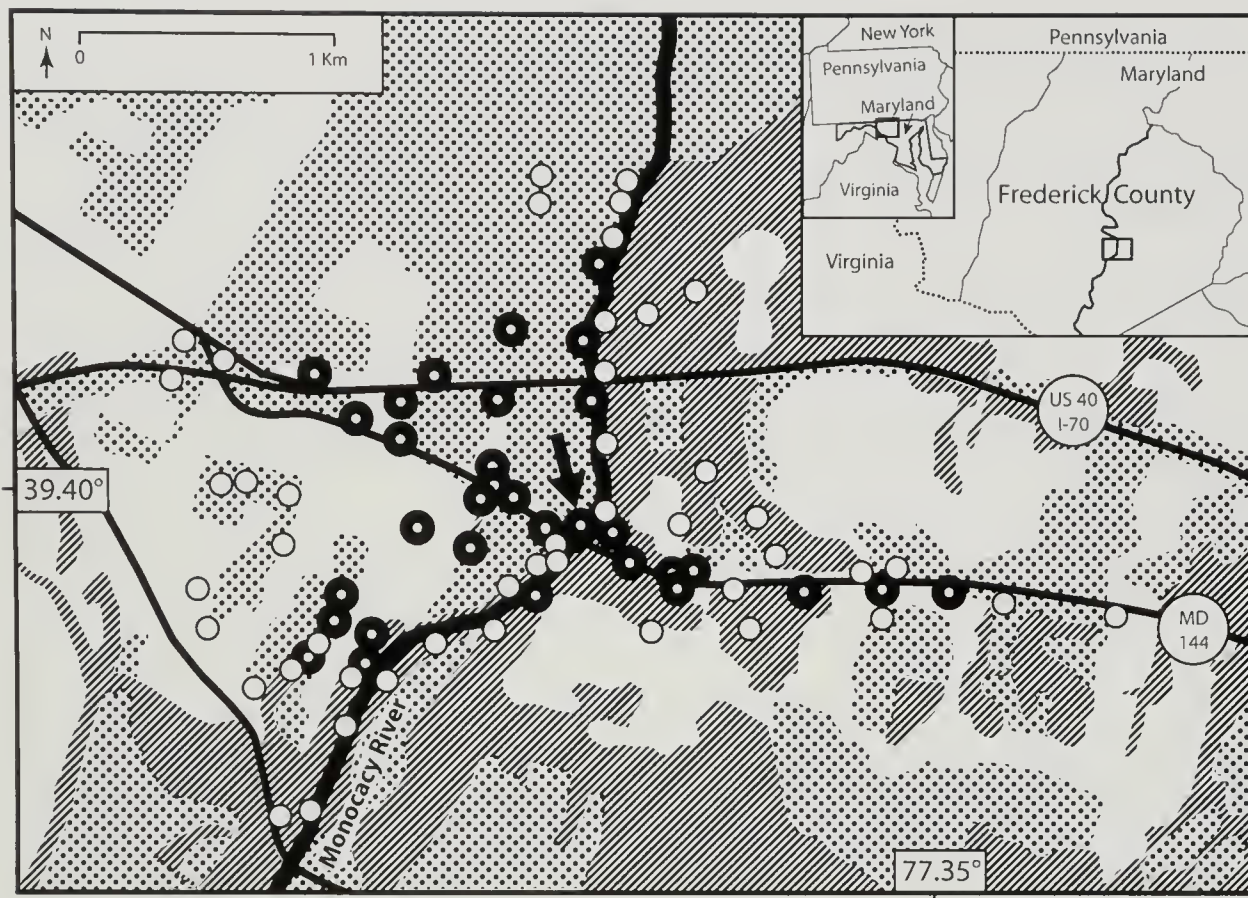


Figure 1. Map of survey area showing localities where *Cepaea nemoralis* was present (closed circles with open centers) and absent (open circles). The arrow marks the site inferred as Wayne Grimm's point of introduction. Land cover is forests (hatched), farm fields (stippled), and developed areas (white). The river in the survey area is approx. 50 m wide and flows south.

1990 when it was decommissioned (Nora Bucke, Maryland State Highway Administration, pers. comm.). According to the USGS 1:100,000-scale topographic map dated 1984 (39077-A1-TM-100), prior to the building of the newest bridge to the north, MD144 also carried the designations US40 and I-70. The west bank of the river has been used for farming and currently has farm fields as well as plots overgrown with weeds, while the east bank has retained more forest cover. Therefore, we infer that Grimm's point of introduction of *Cepaea nemoralis*, which he described as the "the old Monocacy River bridge in Frederick Co., which was the old US40 bridge, right at the weedy spot," was on the west bank of the Monocacy River immediately to the north of the now decommissioned bridge. For measurement of dispersal distances, we arbitrarily designated one of our localities on the west bank closest to the decommissioned bridge (station FR-4; 39.39878°N, 77.36699°W) as the point of introduction (arrow in Fig. 1). As to why Grimm could not locate his point of introduction in 1996, we speculate that he was not aware of changes in road numbers since 1969, and perhaps looked for the "old bridge" in the location of the present US40/I-70 bridge.

Our results show that dispersal of *Cepaea nemoralis* has taken place primarily to the west of the Monocacy River since 1969 (Fig. 1), supporting placement of Grimm's point of introduction on the west bank. The distribution of localities with *C. nemoralis* west of the river is consistent with radiating dispersal starting from one point. Also, the snails dispersed farther upstream than downstream, suggesting that transport

by the river has not been important in their dispersal. In addition, a second and much narrower wave of dispersal has extended eastward across the river, mainly along MD144 (Fig. 1). We speculate that snails either crossed actively using the decommissioned bridge or were transported passively attached to motor vehicles travelling from west to east. Motor vehicles are implicated in dispersing snails eastward along MD144, because all occurrences more than about 400 m east of the river are on the south side of that road. Since traffic moves on the right side of the road in North America, a motor vehicle traveling eastward is likely to drop a snail on the right, on the south side of the road.

The habitats of *Cepaea nemoralis* in Europe include woods, hedges, grassland, roadsides, and railroad banks (Boycott 1934, Kerney and Cameron 1979). North American habitats of introduced *C. nemoralis* include mostly disturbed locations, such as university campuses, parks, residential gardens, fields, river banks, railroads, and roadsides (Reed 1964, Dundee 1974, Forsyth 1999, Schueler 2008, Örstan 2010). The broad habitat tolerances of *C. nemoralis* suggest that habitats in our survey area, which included mostly deciduous forest remnants bordering the Monocacy River, hedgerows, farm fields, roadside ditches, and culverts, would be suitable for the species. However, population densities of *C. nemoralis* among habitats were highly variable. For example, at station FR-38, the corner of a corn field separated from highway I-70 by a hedgerow and approx. 890 m northwest of the point of introduction, we collected approx.

110 shells in an area roughly 10×10 m. In contrast, at station FR-71, a forest remnant approx. 948 m southwest of the point of introduction, a search area that was also approx. 10×10 m yielded only three shells. Also, at several localities, which seemed suitable habitats for *C. nemoralis*, we could not find them. Some of those localities were between others where *C. nemoralis* was present.

Lamotte (1959) described the general distribution of *Cepaea nemoralis* in Europe as patchy colonies occupying limited areas with population densities from one to several hundred. Likewise, Wolda (1969) showed that the densities of *C. nemoralis* along an approx. 1.3-km road varied from one to 66 snails/m. According to Lamotte (1959), the distribution of the species was not continuous because suitable habitats were not continuous, and only a few isolated individuals, forming "migration trails," could be found between colonies.

The patchy distribution and variable densities of *Cepaea nemoralis* in our survey area agree with Lamotte's (1959) model. Presumably, the fastest dispersing individuals form the "migration trails" that cross the less suitable habitats in the shortest possible time. Some of those snails may establish new colonies if and when they reach suitable habitats, which then become new hubs for further dispersal. However, unlike Lamotte's more natural settings where plant cover may have determined habitat suitability, in our area habitat discontinuities arose mostly from humans: roads, buildings, parking lots, etc. Baur and Baur (1990) showed that an 8-meter wide paved road impeded the dispersal of *Arianta arbustorum* (Linnaeus, 1758), a snail comparable in size to *C. nemoralis*, during one 3-month activity season. They also observed that *A. arbustorum* preferred to disperse under the plant cover along roads. Wolda (1969), however, noted that *C. nemoralis* did cross roads. In our survey area, we often found *C. nemoralis* in ditches or hedgerows along roads, indicating that snails can use such suitable habitats to disperse along roads even if they cannot cross them often. The presence of several roads parallel with ditches in the east to west direction may explain the successful dispersal of *C. nemoralis* along the same directions in our survey area (Fig. 1). Also, culverts under many of the roads may have provided passageways for snails. Finally, in 40 years, successful crossing of a road even by a few snails could have founded a new colony on the other side.

The estimated maximum dispersal distances and annual dispersal rates of *Cepaea nemoralis* were: north along the west bank of the river, 1,097 m (27 m/y); west along MD144, 1,253 m (31 m/y); southwest 1,222 m (31 m/y); east along MD144, 1,534 m (38 m/y). These annual dispersal rates are within the range of published maximum active dispersal rates during six months or more for *C. nemoralis* and other land snails of comparable size. Some of the reported maximum dispersal

rates for *C. nemoralis* are 46 m during six months and 67 m in two years (Schnetter 1951) and approx. 16 m in one year (Goodhart 1962). In addition, Cameron (2001) estimated about 10 m per year over more than 60 years for the dispersal of *C. nemoralis* in what he considered was a hostile environment of acidic soil and unstable habitats. Reported maximum dispersal rates for other land snails include 31 m in one year and 25 m in two years for *Helicigona lapicida* (Linnaeus, 1758), a species slightly smaller than *C. nemoralis* (Baur and Baur 2006); 42 m in six months for *Xeropicta derbentina* (Krynicky, 1836), also slightly smaller than *C. nemoralis* (Aubry *et al.* 2006); and 16 m in one year and 15 m in 10 months for *Arianta arbustorum*, a species about the size of *C. nemoralis* (Baur and Baur 1993).

Starting from a single introduction in 1969, the alien *Cepaea nemoralis* has dispersed far and wide in 40 years, and it would not be practical anymore to attempt to eradicate it. Luckily, the species does not appear to have become a pest. *Cepaea nemoralis* will probably continue to widen its range in Frederick County. We may never know what motivated Grimm to start this introduction, but his deed, although condemned in principle, will continue to provide data on snail dispersal for many years to come.

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